RODENT REPELLENT COMPOUNDS

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INTRODUCTION

At the Fifteenth Annual Wire and Cable Symposium, a paper was presented on "Protection of Geophysical, Communication and Power Transmission Cable Against Rodent Species Attack with R-55 Rodent Repellent Treatment." The repellent R-55 is a chemical protectant which has effectively deterred rodent species attack on seismic cables and on buried wire and cable installations. R-55 also has shown a high degree of repellency to insect species such as roaches, termites and ticks. Two R-55 labels have been accepted for registration by the USDA Pesticides Registration Division under the Federal Insecticide, Fungicide and Rodenticide Act. One concerns the solvent treatment of R-55 for the protection of seismic cables. The other is for the use of repellent concentrate 25E in the protective treatment of soil about subsurface cable installations.

Reports were made on the protective treatment of rubber and polyurethane jacketed geophysical cables, and the protection of buried cables by the application of R-55 to the earth immediately surrounding the buried cables.

The first large scale trial of R-55 was the treatment of about 30 miles of buried telephone service cable by the Bixby, Oklahoma, Telephone Company in October 1966. The application of repellent in this field trial was at the rate of two pounds of technical grade R-55 in kerosene diluent per mile of cable. No damage has occurred to the cable since installation in an area of high pocket gopher density.

Then during 1967 the Alberta Government Telephones, Edmonton, Alberta, Canada, used R-55 protective spray application on over 40 miles of buried telephone service cable. This was a continuation of field and laboratory trials of R-55 by Alberta Government Telephones which were initiated in 1966. They have found R-55 repellent to be effective in protecting buried cable from damage of pocket gopher species of the area, and in repelling field mice from pedestal installations.

The R-55 repellent concentrate 25-E is in use as a protectant for military subsurface installations subject to rodent damage. This repellent chemical has been very effective in protecting cables of anodic systems for corrosion prevention in situations formerly experiencing heavy and frequent damage to cables by pocket gophers.

DISCUSSION

The treatment of the soil surrounding buried cables has proven very effective. However, this method requires special equipment and additional manpower when installing the cable. In order to eliminate or at least reduce the need for special handling, plans were formulated to develop a rodent repellent polyethylene compound which could be extruded as a jacket on telephone, geophysical, and other cables. This work has resulted in a high density polyethylene jacketing compound containing an effective amount of R-55 chemical repellent. The experimental resin is designated Marlex* J551. Typical physical and electrical properties of this compound are shown in Table I. The compound has excellent enviromental stress crack resistance and good low temperature properties. Electrical properties are unaffected by the chemical repellent. The compound will meet the requirements of REA Material Specification PE-200, Appendix D, for High Density Polyethylene Jacketing Raw Material. Also, many other current industry specifications for high density polyethylene jacketing compounds can be met by this material.

Marlex J551 resin can be extruded on conventional jacketing extrusion equipment used in the industry. Table II lists the major operating conditions used when jacketing a 50-pair telephone cable. It should be noted that the stock temperature was 430°F. The maximum recommended stock temperature is 450°F. On this particular cable the 10 mil shield normally used on cable to be buried in a gopher infested area was used even with the repellent jacketing compound. The anticipated success of the jacket in deterring gopher damage will allow a reduction in shield thickness on subsequent cables.

During the extrusion of the compound there is an odor resembling the concentrated oil extracts of the onion family, which may be objectionable to some persons. Experience in our laboratories and compounding facilities as well as that of a commercial extruder has shown that mechanical exhaust ventilation applied to the area around the extrusion die reduces the repellent odors to a barely perceptible level. The resulting odor concentrations were not offensive and are well tolerated by extruder operators.

*Trademark for Phillips polyethylenes, polypropylenes and other polyolefin plastics.

In compounds of this type, questions regarding possible corrosion are often raised. Laboratory tests were made by placing corrosion coupons in a test tube containing pellets of J551 resin. The test tube was placed in a container and the container was sealed and placed in an oven. A temperature of 400°F was maintained during the seven-day test period. At the end of the test, the coupons were removed from the fused J551, cleaned and weighed. Corrosion rates were again calculated on the basis of weight change. Data is shown in Table III. It was concluded that the low corrosion rates detected were a good indication that commercial equipment exposed to the J551 would not be damaged by corrosion.

Realizing that a 4 MPY or less corrosion rate would not be detectable on short runs, we still felt it desirable to inspect equipment processing J551. Commercial compounding equipment was inspected before and after a 100,000-pound production run. Also, extruder components such as die, adapter, breaker plate, etc., were inspected before and after 400 hours of service. As expected, no corrosion had developed during either run. Although no long-time exposure tests have been possible, it is believed that equipment damage during extrusion will be unlikely when stock temperatures are controlled below 450°F.

The repellent chemical is distributed uniformly in the compound and in the extruded jacket. The crystalline repellent very slowly migrates to the jacket surface. A fine white powder on the jacket surface is evidence of this migration. This provides a repellent quantity on the jacket surface as well as in the interior of the jacket over a long period. Therefore, the effectiveness of this jacket should exist for a longer time than with solution coated cable or soil treatment as the total amount of chemical is not subject to possible bacterial degradation at one time.

To determine the effectiveness and the term of effectiveness of the repellent jacket, test installations have been made. Cable, jacketed with standard high density polyethylene and with repellent compound, has been placed directly in active gopher runs. Resistance measurements are used to determine relative damage to cables. These test installations are less than six months old, but resistance measurements indicate far less damage to the J551 jacketed cables than with the controls. Plans are to remove these cables at some later date and determine the exact extent of damage on all cables.

Currently, a large scale field installation of Marlex J551 jacketed cable is underway in Northern Iowa in cooperation with Winnebago Rural Telephone Company, Rural Electrification Administration and Superior Continental Corporation. Approximately 400 miles of various size cable has been jacketed. Installation of this cable by the Winnebago Telephone Company was started in June of 1968 and will be completed in 1969. This large field installation, our test installation, and other planned installations will provide information on the over-all effectiveness of this rodent repellent jacketing compound.

In addition to the polyethylene compound for jacketing buried cables, there existed a need for an effective repellent compound for jacketing geophysical cables. The chemical treatment of rubber and polyurethane jacketed geophysical cables by established solvent technique has been in commercial use for several years. These treatments resulted in a very substantial reduction in damage to cables from animal species' destructive attacks. Although effective, this solvent method of treating geophysical cables was time consuming, messy and inconvenient. Also, a very limited amount of chemical could be deposited on or within the cables. A repellent chemical, compounded with special polyurethanes and processed as jacketing for seismic cables, provides a more effective and lasting deterrent to animal damage since a greater amount of repellent can be uniformly distributed throughout the jacket. A polyurethane repellent concentrate is now available. The concentrate can be let down during the jacketing extrusion step into any color of polyurethane. Several cable manufacturers now offer seismic cables jacketed with rodent repellent polyurethane. Many of these repellent jacketed cables are in use by numerous geophysical companies.

CONCLUSIONS

Polyethylene compounds and polyurethane concentrates containing recognized chemical repellents have been developed during the past year. These materials can be extruded on cables using commercial equipment with minimum alteration. Damage to equipment due to corrosion should not occur when using recommended processing conditions. Based on previous experience with the repellent chemical and short term test installations, the resulting cable jacket should be an effective deterrent to damage by pocket gophers. Large scale installation being made at this time will provide information on the total effectiveness of the repellent jacket.

TABLE I

Property	ASTM Test	Value
Density, gms/cc	D1505-63T	0.960
Melt Index, gms/10 min.	D1238-65T	0.2
Environmental Stress Cracking Resistance, hrs. @ F_{50}	D1693-60T	> 1400
Tensile Strength, psi (kg/cm^2)		
20"/min. (508 mm/min.)	D638-64T, Die "C"	3500 (246)
2"/min. (50.8 mm/min.)	of D412-66	3200 (225)
Elongation, %		
20"/min. (508 mm/min.)	D638-64T, Die "C"	90
2"/min. (50.8mm/min.)	of D412-66	500
Izod Impact Strength, ft. lb./in. notch (cmkg/cm)	D256-56	1 (6)
Vicat Softening Point, °F (°C)	D1525-65T	243 (117)
Brittleness Temperature, °F (°C)	D746-64T	< -180 (< -118)
Flexural Modulus, psi (kg/cm^2)	D790-66	137,000 (9650)
Hardness, Shore D	D1706-61	65
Dielectric Constant @ 100 KC	D1531-62	2.60
Dissipation Factor @ 100 KC	D1531-62	0.003
Dielectric Strength, v/mil	D149-61	450

TABLE II

EXTRUSION CONDITIONS

Material	Marlex J551 Resin
Equipment	3 1/2", 24:1 L/D extruder w/100 HP drive - mixing type polyethylene screw
Cable Design	50 pair, 24 AWG - 10 mil HDPE insulation - LDPE inner jacket - 10 mil corrugated copper shield - 35 mil J551 outer jacket
Stock Temperature	430° F
Zone 1	400° F
Zone 2	410° F
Zone 3	420° F
Zone 4	430° F
Line Speed	150'/min.
Amperage	100 amps
Extruder Output - Calculated	440#/hour

TABLE III

CORROSION TEST RESULTS
AVERAGE CORROSION RATE - MPY*

Material	Marlex J551 Resin 400°F
Carbon Steel	3.4
Bronze (85-5-5-5)	0.6
Aluminum (6061)	0.9
316 Stainless	1.1
Hastelloy C	0.3
Stellite No. 6	0.6

*MPY - mils/year.